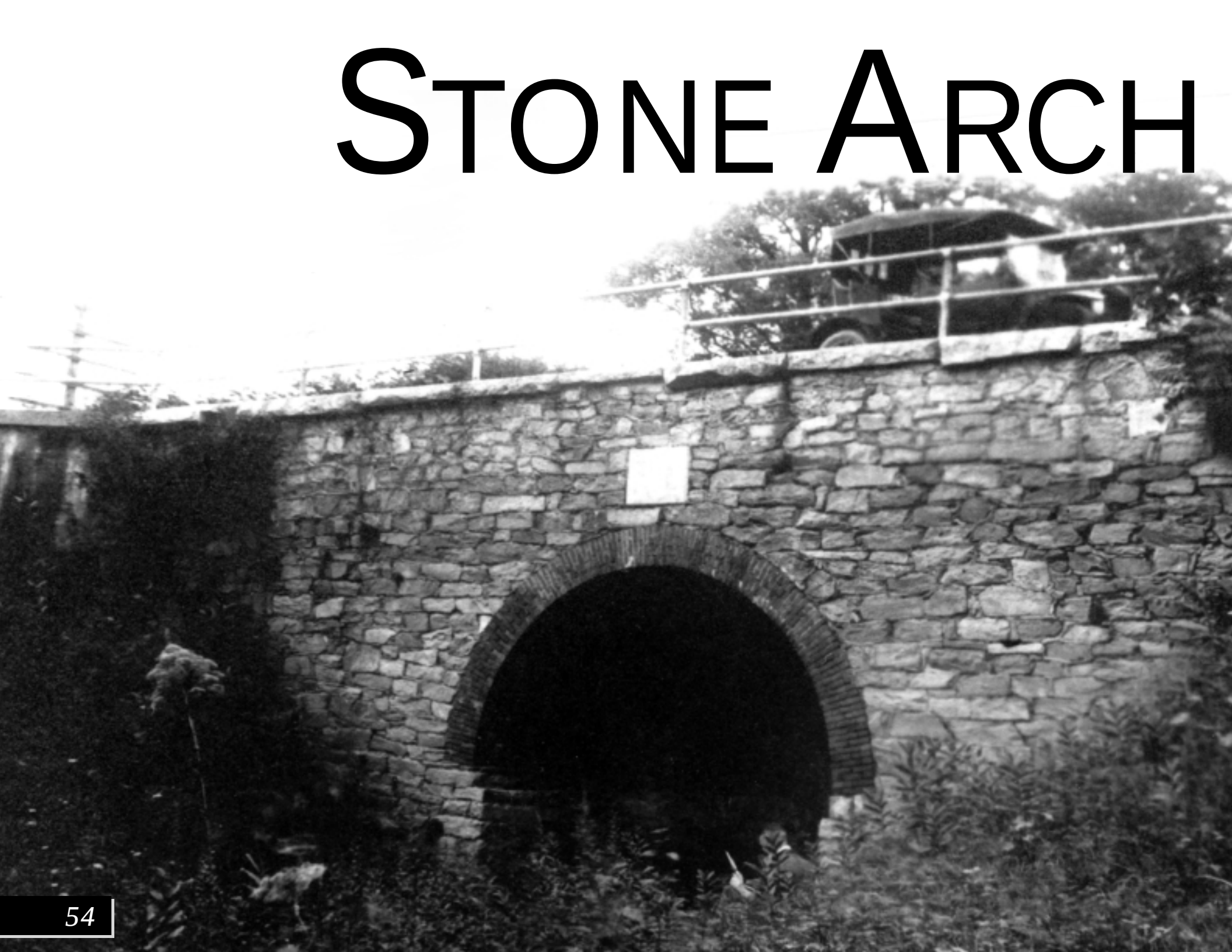
Stone Arch



BRIDGES

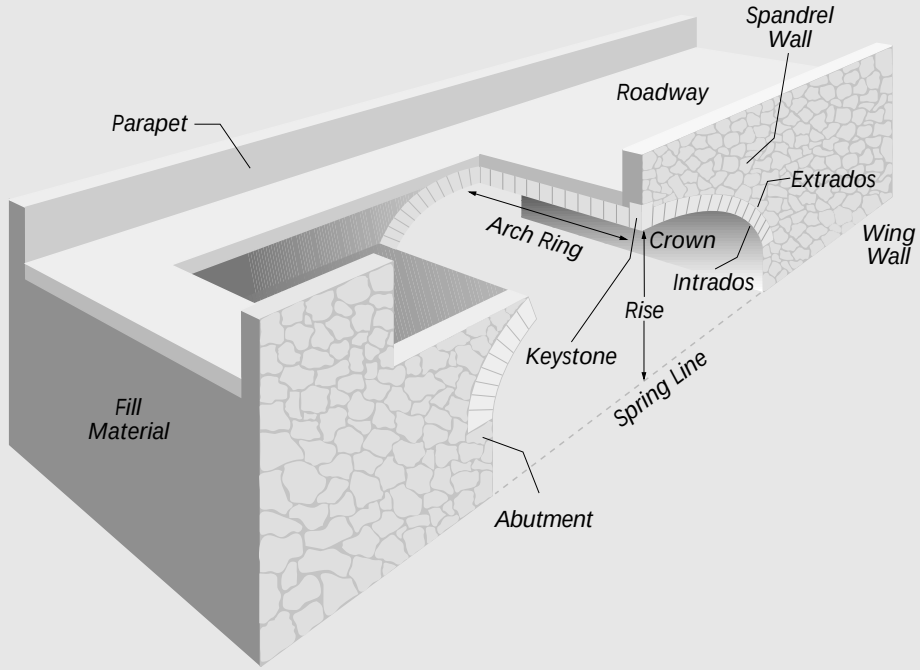
Stone arch bridges still in use on Delaware roads date from about 1810 to 1860.

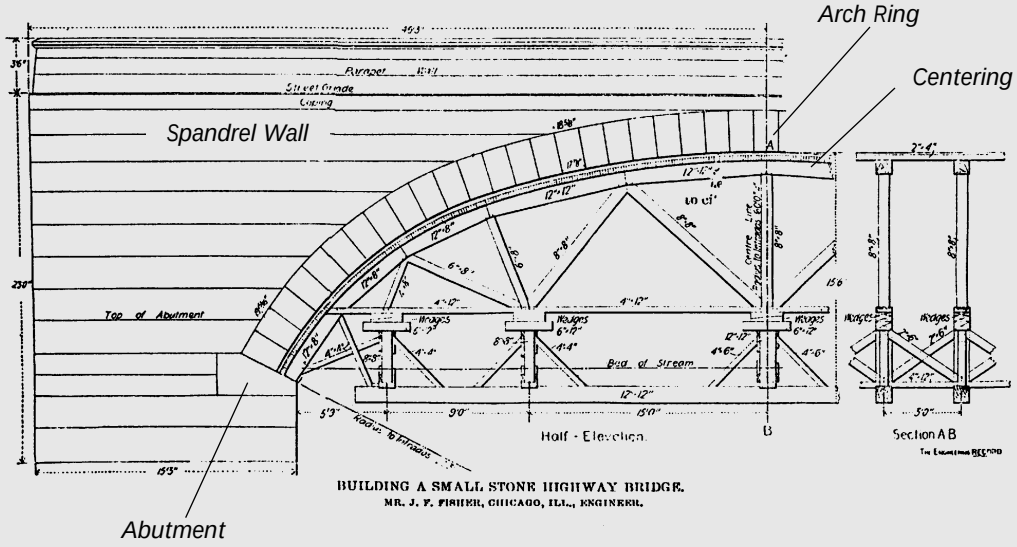
The earliest extant bridge type in Delaware is the stone arch. This was the technology that settlers brought to this country, and it was the technology used when a substantial structure was desired and the building material was readily available. Four stone arch highway bridges remain in service on public roads in the state. All appear to date, at least in part, to the 19th century with the nucleus of the Old Lancaster Pike bridge, southeast of Hockessin, New Castle County (State Bridge NC-617), dating back to the 1808-1811 development of the turnpike.

The arch is curved construction with the convex side upward. It consists of shaped blocks called the arch ring that compress together under vertical loads. To work, the outward thrust at the base of the arch must be countered by the abutments, and the arch ring must be one compression unit. The technology is well suited for the compressive strength inherent in natural rock. Regardless of size or shape, the principle behind the arch remains the same; the vertical forces have to be balanced by equal reactions at the abutments. The arch shape can vary from semicircular to elliptical and segmental.

Lost Delaware Stone Arch Bridges. About 20 stone arch highway bridges are known to have existed in New Castle County in the 1920s. Among them were a stone arch bridge south of Middletown (left), and a bridge near Thompsons Station and the Pennsylvania line (right).

Stone Arches





The arch ring supports the spandrel walls and parapets that hold back the fill placed between the arch ring and the roadway. The parapets in most cases are extensions of the spandrel walls. The arch is constructed by building the abutments and wingwalls and then erecting a wood, arch-shaped form, known as falsework or centering. The arch ring stones, spandrel walls, and parapets are placed, then the structure is backfilled with fill material (usually stones, large rocks and earth), and the falsework is removed, allowing the arch to compress into a locked and stable unit that supports itself through compression.

Left: Stone arch bridges were erected by building the abutments and wingwalls and then erecting a wood, arch-shaped form, known as centering, on which the arch ring stones, spandrel walls, and parapets were placed. This drawing from a late-19th-century textbook showed builders one way of framing the centering.

Stone Arch Bridges

Two-span stone arch bridge (above right) between Newport and Wilmington, New Castle County. No longer standing.

Stone arch bridges were usually laid up with mortared joints, although some were dry laid (no mortar between the stones). Until the late-19th century, the mortar would have been a soft, plastic, lime-based mortar rather than a hard Portland or artificial cement. Portland cement came into common use in the 1880s and 1890s.

Delaware Department of Transportation photographic archives for New Castle County illustrate that about 20 stone arch bridges and culverts existed in that county in the 1920s. No such records remain for Kent and Sussex counties, but stone arch bridges are thought to have been uncommon in the lower counties based on the limited availability of native stone. The majority of documented stone arch highway bridges, and all of the surviving examples, are of rubble-coursed fieldstone. The use of fieldstone illustrates one great advantage of stone arch bridges, the use of a locally abundant natural resource, such as the granite of northern New Castle County. Ashlar masonry

In the early 19th century , turnpike companies built stone arch bridge as part of their road improvements. Stone arch bridges often eliminated fords, which could be seasonally impassable, or replaced timber bridges. They also conveyed a sense of permanency that turnpike companies needed to attract investors and travelers. Among the turnpike bridges in Delaware that had survived into the 1920s were a stone arch on the Lancaster Pike near Hockessin (bottom left) and a stone arch on the Concord Pike (top left). Both bridges are now replaced.

The Locations of Delaware's Historic Stone Arch Bridges

1. Old Lancaster Pike over Mill Creek Tributary
State Bridge NC-617
Hockessin, New Castle County

2. Brackenville Road over Mill Creek
State Bridge NC-177
Hockessin, New Castle County

3. State Route 5 and Smyrna Branch Railroad over Duck Creek
State Bridge K-39C
Clayton, Kent County

4. Rising Sun Lane over Brandywine Creek
State Bridge NC-1
Wilmington, New Castle County

Note: This stone arch span is the approach span to a metal truss bridge and its individual history therefore appears in the metal truss chapter See p. 80).

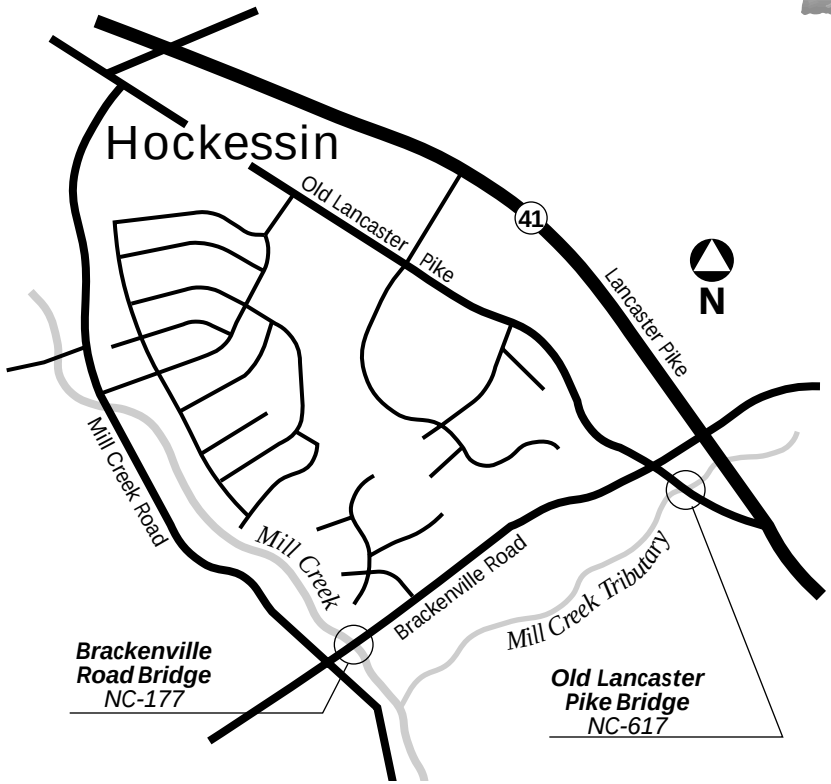
was used in Delaware primarily by the railroads beginning in the last quarter of the 19th century. The state has several large and impressive railroad stone arch bridges including the 1904 Pennsylvania Railroad viaduct in downtown Wilmington and the 1909-1910 B&O (CSXT) bridge over the Brandywine River, north of downtown Wilmington at the Augustine Cut-Off.

About the mid 1880s, the general acceptance of metal truss bridge technology for highways marked the waning of stone arch highway spans. After the turn of the 20th century, however, stone was used more often as a decorative, non-structural veneer on other types of bridges, like reinforced concrete rigid frames or concrete encased multi girders.

The four stone arch highway bridges still in use on Delaware roads date from about 1810 to 1860; three are located in New Castle County, the fourth in Kent County. The oldest documented example is the Old Lancaster Pike bridge (NC-617), which also holds the distinction as the only surviving stone arch bridge associated with Delaware's early 19th century turnpike era.

The next oldest stone arch highway bridge is the approach span to the Rising Sun Lane bridge (NC-1). This 25'-long stone arch span over a former mill race was built in 1833 with a Burr arch-truss covered bridge over the Brandywine River's main channel. The covered bridge was replaced by a steel truss bridge in 1928, but the stone arch approach span was retained. Both spans are discussed in the metal truss bridge chapter.

The other stone arch bridges are the 1846 Brackenville Road over Mill Creek bridge (NC-177), southwest of Hockessin, New Castle County, and the circa 1860 State Route 6 over Duck Creek bridge (K-39A) between Clayton and Smyrna, Kent County. They have undergone 20th-century alterations including widening, but 19th-century stone arch elements remain.



The only known surviving bridge from Delaware's turnpike era is the ca. 1808-11 Old Lancaster Pike over Mill Creek Tributary bridge (State Bridge NC-617).

Old Lancaster Pike over Mill Creek Tributary bridge. Arch ring detail showing rubble granite spandrel walls and voussoirs, (State Bridge NC-617).

Old Lancaster Pike *(Road 300)* over Mill Creek Tributary

State Bridge NC-617
Southeast of Hockessin, New Castle County
Designer/Builder: Unknown

ca. 1808-1811

The Old Lancaster Pike bridge is Delaware's oldest stone arch highway bridge and the only surviving bridge associated with the state's early 19th century turnpike era. It is a skewed, 12'-long span carrying two lanes of traffic on a 26'-wide deck. The bridge has rubble granite spandrel walls and rusticated voussoirs. The parapets are finished with concrete caps that replace the original stone capstones. No original plans or drawings are on file at the Delaware Department of Transportation, but field investigation indicates that the bridge was widened in kind to both sides

B&O Railroad's Brandywine Viaduct

Delaware's most visually impressive stone arch bridge is the 1909-1910 Brandywine Viaduct built by the Baltimore & Ohio Railroad over Brandywine Creek in Wilmington. The seven-span bridge is slightly less than 1,000' long and rises over 110' above the creek. The bridge was built as the railroad's replacement of an 1888 iron deck truss bridge, which had proven inadequate to heavier locomotives. Although the B&O could have chosen to build another steel truss bridge, or a reinforced concrete bridge, there were few bridge types that spoke to permanency and stability as well as a stone arch, even if stone construction was very costly. The stone arch bridge was built on a slightly downstream alignment of the older truss bridge.

The Brandywine Viaduct is a testimony to the economic might and competitive spirit of America's railroads during their golden age. Two rival railroads that competed for dominance of major eastern markets were the Pennsylvania Railroad and the B&O Railroad. In 1902, the Pennsylvania Railroad embarked on a major program to rebuild its line, replacing many iron bridges with trademark stone arch bridges, such as the viaduct adjacent to its train station in downtown Wilmington. The rival B&O felt obliged to follow suit, and also built several stone arch bridges.

The B&O Railroad's Brandywine Viaduct, photographed shortly after it opened in 1910. In the background is the 1888 iron truss bridge it bypassed. In the foreground is a pedestrian suspension bridge that was used by workers walking to and from the mills that then lined the Brandywine Creek.

Historians of the B&O Railroad have often criticized its management for expending capital on a line that never proved exceptionally profitable, depleted the B&O treasury, and left it financially vulnerable.

The iron truss bridge abandoned by the railroad in 1910 was transferred to the City of Wilmington, which converted the bridge for use by pedestrians and motorized vehicles. The state highway department built a road from the eastern end of the truss bridge to the Concord Pike in 1933. The road, which made a more direct connection between the Trolley Square section of Wilmington and the expanding North Wilmington suburbs, was called the Augustine Cutoff, and the truss bridge has since been known as the Augustine Cutoff bridge. The deck truss superstructure was replaced by DelDOT in 1980. ■

by approximately 5', probably near the turn of the century. The nucleus of the stone arch span is believed to date to the construction of the 1808 to 1811 Newport-Gap Turnpike, later known as the Lancaster Pike.

The Newport-Gap Turnpike was the first turnpike chartered by the Delaware General Assembly, authorized on January 30, 1808. The route ran from Newport to Gap Tavern in Lancaster County, Pennsylvania, to link with the Philadelphia & Lancaster Turnpike, constructed in 1793. The Newport-Gap Turnpike provided an important commercial link between the farms of Lancaster County, Pennsylvania and the ports of Wilmington and Newport. Access to these ports and overseas markets stimulated the trade economy of both areas. This section of the turnpike remained the main road from Wilmington to Lancaster until the late 1940s, when it was bypassed by a realignment of State Route 41.

Brackenville Road *(Road 274)* over Mill Creek

State Bridge NC-177
Southwest of Hockessin,
New Castle County
Designer/Builder: Unknown

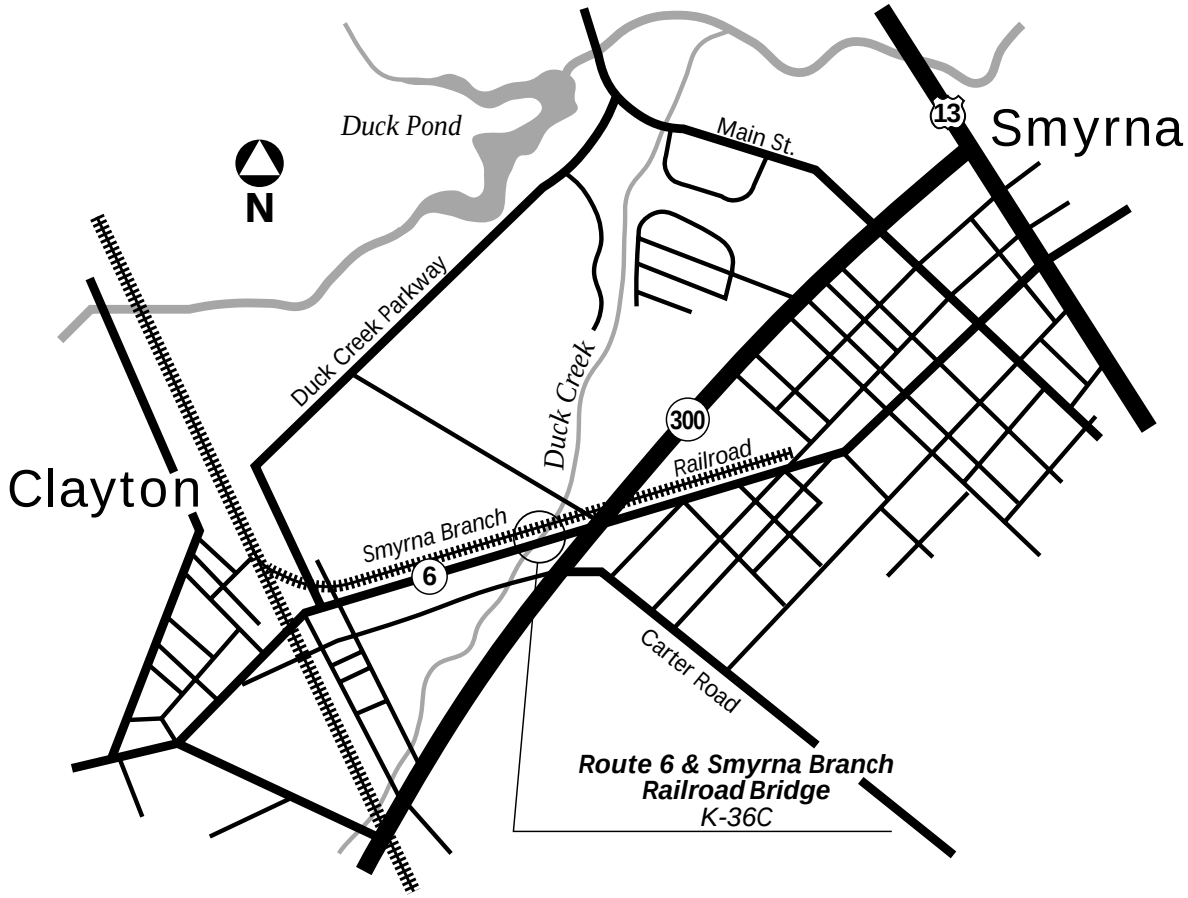
1846

Brackenville Road over Mill Creek bridge is a single-span, 26'-long, stone arch bridge with rubble fieldstone spandrel walls, arch ring, and voussoirs. The bridge was widened in 1965 by the addition of a cantilevered concrete slab deck that resulted in the removal of the stone parapets. In 1996, the Delaware Department of Transportation replaced the 1965 deck with another precast concrete slab deck with 3'-wide cantilevered overhangs and metal beam guide rails. The arch intrados is coated with shotcrete, and the spandrel walls have been repointed and patched with concrete. The

Brackenville Road bridge (State Bridge NC-177) is a one-span, 26'-long stone arch bridge.

Brackenville Road bridge as it appeared in 1921, before the parapets had been removed and the cantilevered concrete slab deck added in 1965.

The datestone in the spandrel wall reads "N. C. C. 1846," indicating the stone arch was built under the auspices of New Castle County's Levy Court.



State Route 6 and Smyrna Branch Railroad over Duck Creek

State Bridge K-39C
Clayton, Kent County
Designer/Builder: Unknown

ca. 1860

The skewed, one-span, 18'-long bridge consists of a 35'-wide rubble stone arch on its south (upstream) side to carry two lanes of State Route 6 and a 29'-wide reinforced concrete arch on its north (downstream) side to carry the abandoned right-of-way of the Smyrna Branch Railroad. The date of construction of the stone arch is ca. 1860 based on its style and local history. The date of construction of the reinforced concrete arch is 1916 based on an inscription in the plain concrete spandrel wall. A concrete sidewalk and a metal beam guide rail were added to the stone arch side of the bridge ca. 1969. Flared concrete

bridge was documented to Historic American Engineer Record standards in 1996. The 1846 stone arch bridge, although altered from the deck up, is one of only four stone arch highway bridges identified by the survey. It is historically significant based on the rarity of traditional stone arch highway bridges in the state.

wingwalls were added to the south side in 1984 as part of a project to channelize the stream. Although altered, the bridge is one of only four remaining stone arch highway bridges in Delaware and the only identified example of a traditional stone arch highway bridge south of the canal.

The stone arch bridge was probably built to provide a permanent crossing of Duck Creek on the road from Smyrna to Clayton after the latter town was established as a station stop on the Delaware Railroad in 1856. The one-mile long Smyrna Branch Railroad was established in 1866 as the Smyrna Station and Smyrna Railroad by local business interests who desired a better connection with the main line. In 1916 the branch line was regraded and the bridge widened with the reinforced concrete arch addition by the Delaware Division of the Pennsylvania Railroad, which took control of the line in 1901. The branch line was abandoned after 1967. ■

The State Route 6 over Duck Creek bridge is Kent County's only example of a stone arch highway bridge. It is believed to date to ca. 1860 and was probably built to provide Smyrna's citizens with a permanent crossing of Duck Creek on the road to the railroad station at Clayton. The bridge has undergone numerous alterations, including widening with a reinforced concrete arch in 1916 to accommodate a railroad branch line.